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1-12-2021

## Proposing an Information Value Chain to Improve Information Services to Disabled Library Patrons Using Assistive Technologies

Devendra Potnis

*University of Tennessee, Knoxville, [dpotnis@utk.edu](mailto:dpotnis@utk.edu)*

Kevin Mallery

*Western Carolina University, [kjmallery@wcu.edu](mailto:kjmallery@wcu.edu)*

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### Recommended Citation

Potnis, D. & Mallery, K. (2021). Proposing an information value chain to improve information services to disabled library patrons using assistive technologies. *Journal of Information Science*. <https://doi.org/10.1177/0165551520984719>.

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Recommended citation: Potnis, D. & Mallary, K. (2021). Proposing an information value chain to improve information services to disabled library patrons using assistive technologies. *Journal of Information Science*. <https://doi.org/10.1177/0165551520984719>.

## **Proposing an Information Value Chain to Improve Information Services to Disabled Library Patrons Using Assistive Technologies**

### **Abstract**

Information services offered by academic libraries increasingly rely on assistive technologies (AT) to facilitate disabled patrons' retrieval and use of information for learning and teaching. However, disabled patrons' access to AT might not always lead to their use, resulting in the underutilization of information services offered by academic libraries. We adopt an inward-looking, service innovation perspective to improve information services for disabled patrons using AT. The open coding of qualitative responses collected from administrators and librarians in 186 academic libraries in public universities in the United States, reveals 10 mechanisms (i.e., modified work practices), which involve searching, compiling, mixing, framing, sharing, or reusing information, and learning from it. Based on this information-centric reorganization of work practices, we propose an "information value chain," like Porter's value chain, for improving information services to disabled patrons using AT in academic libraries, which is the major theoretical contribution of our study.

**Keywords:** Disabled patrons, information services, service innovation, assistive technologies, academic libraries, information value chain

## **1. Introduction**

In the digital age, organizations increasingly rely on a range of technologies to offer information services to patrons [1, 2]. Information services afford patrons access to information and assist in the creation, storage, or use of information [3, 4]. Information organizations like academic libraries increasingly rely on assistive technologies (AT) to provide information services to patrons with disabilities – here onward referred to as disabled patrons – who comprise 19 percent of undergraduate students and 12 percent of graduate students in the United States [5].

An assistive technology is “. . . any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities” [6]. AT help disabled users better interact with, process, and apply information for learning and teaching. For instance, screen readers (e.g., JAWS), can help visually impaired students read PDF documents [7]. Hearing-impaired students can use amplification systems (e.g., FM systems, hearing aids), transcription services (e.g., C-Print, and TypeWell), or captioning tools to process Audiovisual recordings [8]. Students with Learning disabilities, including dyslexia, can read and write more fluently using literacy or speech recognition applications (e.g., Read & Write Gold, New Dragon, Nuance Dragon, and Sonix) [9]. Patrons who have difficulty with dexterity may benefit from adaptive keyboards (e.g., BigBlu Kinderboard) as well as trackballs, adaptive joysticks, and other peripheral devices [10]. Thus, AT are increasingly essential for providing information services to disabled patrons.

## **2. Research Objective**

Although disabled patrons may be able to access AT provided by academic libraries, these patrons might not use, or benefit from using, the tools provided. This underutilization suggests that service providers like academic libraries might not always be able to meet the information needs of, and create value for, all patrons [11, 12]. Nearly half of students with disabilities in the United States perceive that their academic institutes provide limited or no support in the form of information services using AT [13]. Given the substantial resources that academic libraries

invest in providing information services, these libraries face ongoing pressure to enhance their services [1, 14, 15]. Academic libraries routinely explore the best practices for delivering information services to disabled patrons using AT.

Any service is typically a configuration of people, information, and technologies that are expected to function in unison to create value for patrons [3, 16, 17]. The interactions among these three resources are informed by organizational work practices, which also shape the degree to which patrons benefit from services [2, 17]. Hence, we pose the following research question.

- Which modified work practices might help academic libraries improve information services to disabled patrons using AT?

We approach this question from a service-provider perspective since an organizational environment significantly influences patrons' reliance on technology for accessing, searching, storing, and using information [18]. Babu and Xie [7] recommend that academic libraries be innovative to help disabled patrons meet their information needs, whereas practitioners ask academic libraries to adopt combinations of new ideas, processes, teams, and work practices [19] to improve information services. Through service innovation, organizations can improve their information services by transforming information into value-creating activities [3, 20].

### **3. Literature Review**

#### **3.1 Service Innovation**

Service can be defined as a process of applying resources exchanged among multiple actors to create tangible and intangible benefits for one or more actors [11]. Services can provide value for customers by transforming activities, helping them process information and acquire knowledge, and solve problems [21]. Services can also create value for the organization and its customers by introducing and improving work practices [20]. Such innovation requires the re-bundling of a myriad of resources [22].

According to den Hertog [23], organizations can implement service innovations in four ways: (a) propose a service concept, wherein a new value proposition is offered to customers

[24]; (b) design user-friendly client interface, i.e., changes in the way clients are involved in the service design and delivery; (c) transform the organization's work practices to improve the existing service delivery system; and (d) implement technologies for more effectively delivering the service [21]. Our study focuses on the "service delivery system" type of service innovation, in which the reconfiguration of organizational work practices and resources can create value for internal and external stakeholders of a system [25].

We do not employ any service innovation theory or model for two reasons: (a) most of these models and theoretical frameworks are specific to for-profit organizations; also (b) service innovation models for nonprofit organizations treat them as standalone and independent entities. In contrast, academic libraries operate neither as for-profit nor standalone organizations. Instead, they exist within bureaucratic, nonprofit institutions such as colleges or universities. Hence, we approach the research question using the theoretical constructs of resources and mechanisms from the service innovation literature.

### *3.1.1 Resources and Mechanisms: Theoretical Constructs*

Resources, which include tangible and intangible goods (e.g., technologies) and skills [26], are essential for implementing service innovations [27]. Social exchanges in organizations can make resources interact with each other, thereby benefitting patrons and other stakeholders [26]. To facilitate these exchanges, institutions can establish service ecosystems guided by policies and procedures [3, 28]. If service providers fail to manage the exchange of resources, patrons may decide against using services [25].

Mechanisms refer to the work practices that exploit, integrate, or exchange resources in an organization. Interactions among resources yield various benefits during the service innovation process [25]. This paper treats academic libraries as a socio-technical system with physical and technological resources, including AT.

## **3.2 Mechanisms for Providing Information Services to Disabled Patrons**

Past research on the provision of AT in academic libraries recommends the following work practices. One set of best practices is ensuring that electronic and physical resources are accessible [29, 30]. To ensure the accessibility of their electronic resources, academic libraries can demand that publishers provide accessible materials that adhere to the Web Content Accessibility Guidelines and are compliant with federal regulations (e.g., Americans with Disabilities Act, Rehabilitation Act) [31—33]. Physical spaces can be made accessible by offering convenient parking, clear signage, navigable shelves, and adjustable-height desks [34—36].

The second set of best practices for academic libraries is to partner with internal and external stakeholders. Internally, academic libraries can collaborate with disability support and information technology services to identify disabled patrons' needs; conduct accessibility audits; craft accessibility plans and requirements for vendors; market AT and provide training to disabled patrons; routinely maintain AT; and jointly apply for grants to purchase new AT [37—41]. Academic libraries can also partner with peer institutions, corporations, governmental agencies, and nonprofit entities (e.g., The Global Public Inclusive Infrastructure) to provide the most cost-effective information services [42, 43]. Partnering with disabled patrons through surveying or interviews can further help academic libraries understand their needs [34, 41, 44] for effectively delivering information services.

None of the past recommendations for offering information services to disabled patrons in academic libraries focus on the role of information in creating value for patrons, which, we argue, is a missed opportunity for the following reasons. Resources are critical, and are exploited, integrated, or exchanged, for service innovations [27]. Information organizations like libraries often have limited or no access to resources but are surrounded by information. Information is crucial for facilitating more frequent quality interactions among people, organizations, and technologies, and thereby generating value for organizations and their

customers [2, 3, 45]. Information is also a unique resource, since, unlike money or human capital, it does not deplete.

### **3.3 Information for Creating Value through Service Innovation**

After analyzing 37 research papers published in top journals in management science, information systems, service research, and innovation management, Kleinschmidt, Peters, and Leimeister [46] reveal the significance of “information” as a resource for understanding, designing and implementing, operating and changing, and creating value for patrons. To create value for patrons, Villarroel Ordenes et al. [47] recommend infusing information into interactions among people, technology, and organizational context. Libraries can create value for their patrons by reproducing, exchanging, transferring, refining, analyzing, interpreting, and regenerating information [48]. Academic libraries can involve patrons for co-creating value for them through meaningful dialogue, in which libraries make their information resources available to patrons through workshops, Web portals, and social media [20].

Thus, organizations can meet the expectations of patrons by transforming information into valuable services. However, the process of transforming information into value-creating activities is a major challenge for organizations engaged in service innovation [26], which is also an understudied area. Our study fills in this gap.

## **4. Methodology**

### **4.1 Survey Instrument**

We adopted the system analysis and design approach [49], a popular service technique in information systems research when designing our survey to understand how service innovations can help academic libraries better serve disabled patrons. Consistent with this approach, we designed research questions that map onto the following five phases of offering information services to patrons using any technology: planning (e.g., searching for AT), analysis (e.g., evaluating available AT), design (e.g., designing library policies for using), implementation (e.g., deploying newly purchased AT in libraries, training librarians for serving disabled patrons using

AT), and maintenance and support (e.g., maintaining AT, helping patrons use and benefit from AT). Our approach is consistent with Vincent [50] who recommends similar steps for implementing AT in libraries.

This paper reports findings from a survey designed as part of a larger research project focusing on strategic investments in and provision of AT. Findings in this paper are based on select items from our survey, specifically how respondents envision transforming their work practices to better deliver information services to disabled patrons (See Appendix). To ensure that responses were from academic library administrators and staff members, we asked respondents to confirm their job titles. Additionally, we confirmed whether respondents' libraries provide AT. After revising the wording of our survey, which was then approved by our university's institutional review board, we proceeded with data collection.

#### **4.2 Study Population and Data Collection**

This study involved 186 administrators and 321 librarians in academic libraries at 186 public universities, which were among the top 200 academic institutes listed in the U.S. News & World Report's publication, "2018 Best National Universities." We collected email addresses of the dean, director, or head of an academic library at every university, and identified the librarians responsible for serving disabled patrons in the same academic libraries. An online survey developed using Qualtrics was emailed to all potential participants individually, followed by a gentle reminder to take the survey. Overall, 50 administrators and 22 librarians completed the survey, with a response rate of 14.2%.

Distributing an anonymous online survey was one of the most effective ways of collecting experiences, reflections, and guidance from the administrators and librarians of the top-200 academic libraries in the US for five reasons. First, administrators of these academic libraries are busy because they are responsible for leading libraries with operational budgets of more than one million dollars a year. Interviewing them for a research study would have proved challenging given their hectic schedules. Second, we asked them about inefficiencies in their large academic



libraries. It is unlikely that any leader or their staff would, during a recorded interview with strangers, disclose the details of the underutilization of resources and services in their libraries, because admitting to mismanagement of resources and finances could be perceived as a failure. Third, the online survey format gives respondents enough time to think about questions. Interview questions can put participants on the spot. Fourth, an anonymous survey made it safer for library administrators and staff to report ineffective and inefficient work practices. Finally, it was cost-effective for researchers to collect data using an online survey [20, 52].

### **4.3 Analysis**

Using open coding [53], we analyzed (a) how respondents address the challenges encountered during planning, analysis, design, implementation, and maintenance of AT, and (b) the top-three changes planned by them for better serving disabled patrons using AT. Open coding is a popular technique for analyzing qualitative data. Several qualitative data analysis methods, including grounded theory, incorporate this technique [54, 55]. Open coding includes labeling concepts and defining and developing categories based on their properties and dimensions [55]. Concepts are abstract representations of events, actions, objects, or interactions, which help researchers group similar information to better understand the data [55, 56].

Reading over 1,400 quotations from 72 respondents, line-by-line, we identified 10 mechanisms that could improve the delivery of information services. After comparing relations, similarities, and dissimilarities among these concepts, we grouped them into five clusters: Behavioral, Knowledge Integration, Innovation, Cognitive, and Technology Integration mechanisms (See 5.1). For instance, researchers found that strengthening existing partnerships, repositioning current ties, and improving dialogue with patrons are three related concepts concerned with the behaviors involved in providing information services to disabled patrons, and hence, these three concepts were clustered under “Behavioral mechanisms.” The intercoder agreement during the coding process was more than 90%. Data analysis lasted for over four months.

## 5. Findings and Discussion

All the respondents confirmed that they work in academic libraries with an operating budget greater than one million dollars. Job titles of administrators include dean ( $n = 19$ ), director ( $n = 11$ ), strategist ( $n = 2$ ), unit head ( $n = 11$ ), and associate librarian with administrative responsibilities ( $n = 7$ ). Librarians who participated in our study primarily work in services related to access, instructional technology, reference, user experience, community outreach, and distance learning. All the respondents confirmed serving their library patrons using AT.

Based on the responses we collected, academic libraries belong to “information service systems,” along with other units, which collaborate to provide technical, academic, and administrative services, including information services to disabled patrons via AT. Past literature on research data management services offered by academic libraries also found that academic libraries cannot offer such services in isolation [57]. As a result, multiple units in the same institution might compete with or collide against each other when sharing, mixing, and using resources for serving patrons [58], thereby affecting the serving quality.

### 5.1 Mechanisms for Improving Information Services Using AT

In the context of this current study, mechanisms represent modified work practices that exploit, integrate, or exchange information, and in turn, the information-centric reorganization of work practices for enhancing the quality of information services offered to disabled patrons. Table 1 summarizes the way this paper meets the research objective.

#	Modified Work Practices
1	Behavioral mechanisms: Strengthening existing partnerships; Repositioning current ties; and Improving dialogue with patrons
2	Knowledge integration mechanism: Environmental scan; Professional development of staff; and Automation
3	Innovation mechanisms: Building new teams; and New outlook, norms, and methods for seeking funds

4	Cognitive mechanism: Moral and ethical responsibilities
5	Integration mechanism: Integrating AT with space and facilities

*Table 1. Key Findings: Modified Work Practices to Improve Information Services*

#### *5.1.1 Behavioral Mechanisms*

Behavioral mechanisms help organizations build high-quality connections among actors [25]. Such connections, like the ones among partners of an ISS, are associated with increased levels of psychological safety and trust. Higher levels of psychological safety contribute to learning from failures and reliance on fellow stakeholders [59]. Greater levels of intra-organizational trust can spawn increasing cooperation [60].

##### *5.1.1.1 Strengthening Existing Partnerships*

Respondents propose strengthening existing partnerships with other units of an ISS through proactive communication. As academic libraries continue to redefine their information services using technology, they need to leverage their strengths and innovate to create robust services [14]. Proactive communication and cooperation with other units of ISS, especially with disability support services, can help libraries manage enough AT inventory. For instance, academic libraries need to know how many students are registered with disability support services, as well as the types of disabilities these students possess. If the library knows that most students reporting disabilities on campus are visually-impaired, it should provide enough large-screen computer monitors, or workstations with JAWS screen-reading software installed, to accommodate them.

Ongoing dialogue among partners of the ISS can generate timely awareness of users' needs so that service providers can better manage and integrate their resources. As an administrator in our study shared: "We know what the standard technologies are, but since we do not have a staff member whose job it is to identify other assistive technology, we depend on the Disabled Student Group to let us know what they need. It would be better to be able to ask them

if something we hear about would work for them, rather than them having to come to us to ask if we can provide it to them.” Librarians in our study desire more on-campus interactions with stakeholders. Open communication channels between partners of an ISS can be a win-win solution. For instance, plural among the academic library, Office of Student Disability Services, and students at the City University of New York helped their ISS address accessibility concerns related to electronic resources [39].

#### *5.1.1.2 Repositioning Current Ties*

Librarians in our study would like to reposition internal ties, whereas administrators intend to cultivate relationships with external partners. For instance, librarians express the need for increased administrative support. They also recommend having more than one librarian responsible for aiding patrons with AT, which would enhance the quality of information services and strengthen ties between patrons and librarians. Because academic libraries must compete with other members of the ISS for valuable resources, librarians in our study would like their administrators to exert greater “political will” when advocating for their libraries.

Many academic libraries form partnerships to share resources and increase their return on investment in those resources. Libraries can also benefit from collaborating with vendors [19]. Libraries in our study work in tandem with external vendors to provide AT. However, to garner higher returns from existing partnerships, administrators plan to reassess and reposition their existing ties with external actors. Administrators plan to seek guidance from experts in diverse but related fields by (a) forming an advisory board of individuals with disabilities for strategic planning; (b) prioritizing changes in libraries; (c) revising programs in their libraries to better capture, understand, meet the evolving needs of disabled patrons; and (d) decentralizing control and decision making—within reason—to empower frontline personnel.

Administrators who participated in our study plan to invite AT manufacturers and vendors for usability testing sessions in their libraries, during which recommendations for improving the tools can be made. They intend to test the compatibility of AT with other software, enhance

website accessibility, and develop universal wayfinding technologies to help patrons locate AT within the facility. Further, they plan to renegotiate existing contracts with AT vendors to include enhanced customer service and better technical training opportunities for librarians. Finally, the administrators intend to collaborate with other universities by building a consortium to offer better information services.

#### *5.1.1.3 Improving Dialogue with Patrons*

The more a service relies on knowledge of, and adaptation to, patrons' needs, the greater the benefit realized by those patrons [20]. The effectiveness of a service depends on the amount of direct contact that a patron has with the service provider. Most respondents in our study state that libraries should directly communicate with students with disabilities to learn about their needs, complaints, and dissatisfactions, which was also recommended by Guder [39], a practitioner with prolonged experience in delivering AT. During town hall meetings, students can share their AT needs—specifically their concerns regarding the accessibility of electronic resources—with academic librarians [37]. Potnis et al. [18] also suggest active involvement with patrons when developing and managing library resources. Librarians in our study recommend establishing a formal channel of communication to soliciting patrons' feedback.

In our study, a dean of libraries and information resources shared a problem regarding disabled patrons' awareness of AT: "[The] library is not known for being an area where AT . . . is available." To raise awareness of available AT, academic libraries can use their websites to highlight specific AT and related services available to students with disabilities [39]. Further, contact details of the staff member responsible for managing AT should be displayed on the website so that students may address any accessibility questions or concerns. Potnis et al. [18] recommend that libraries advertise their technologies and services to improve patrons' perceptions of them. In our study, some librarians and administrators expect to introduce novel ways of enhancing outreach to patrons: starting a helpline, providing a 24/7 chat service, producing online tutorials and webinars, displaying informative signage at ADA workstations, and

distributing handouts pertaining to AT. These planned efforts reflect respondents' intent to facilitate direct communication with students so that existing services can be improved. They plan to inform students about the equipment that libraries provide. Doing so can enhance libraries' reputations, and at the same time, make students feel more comfortable when asking librarians for assistance with AT. Partners of academic libraries in the ISS should also promote AT.

#### *5.1.2 Knowledge Integration Mechanisms*

Knowledge integration mechanisms represent a set of decisions and actions for assimilating external and internal knowledge sources from patrons and partner organizations [61, 62]. Sample external knowledge sources for better serving patrons include patrons' technical needs, changes in the AT landscape, and training opportunities provided by vendors. Internal knowledge sources include awareness of the AT provided by the ISS, the nature of disabilities reported by students on campus, librarians' and staff members' knowledge, and "self-service" training documentation for patrons. Environmental scanning, professional development, and automation, which are mechanisms identified in our study, can help library administrators and librarians combine existing organizational expertise with newly acquired knowledge. Gathered from internal and external sources, this newly acquired knowledge can be integrated with prior knowledge so that members of the ISS can create the most value for stakeholders, including disabled patrons.

##### *5.1.2.1 Environmental Scan*

In-depth research for environmental scanning is another major change proposed by respondents. As part of the "look internally" approach suggested by Islam et al. [20] for managing knowledge in libraries, they expect librarians to (a) develop their understanding of innovations and gather more knowledge about what is possible, and (b) interact with patrons to learn more about their needs. Administrators in our study also plan to create more awareness among librarians about potential innovations and encourage them to gather more knowledge of AT. They ask librarians to invest time in finding out more about all the campus resources available for serving disabled patrons. Proactively gathering data from patrons can increase librarians' awareness of the

challenges encountered. Librarians should therefore educate themselves about the availability of new AT on the market. Administrators intend to invest in guides about the best technology and conduct extensive research before investing in AT. Librarians think it is important to know more about their legal obligations.

Administrators surveyed in our study believe that librarians should learn which technologies are available on their campuses and where they are deployed. Librarians echo this sentiment by expressing the desire to know the range of AT used by libraries for serving disabled patrons.

Respondents plan to invest in the appropriate guiding material for librarians using AT. They look forward to providing better-designed software, as well as “quick start” guides to help answer any questions or concerns that frontline employees might have about AT. Administrators believe that the availability of self-paced instructional materials produced for librarians can be of great benefit. Finally, administrators in our study are always in search of external actors who may be interested in forming mutually beneficial relationships with members of the ISS.

#### *5.1.2.2 Professional Development of Staff*

Librarians in our study expect more training to develop their expertise. They desire workshops for staff, student workers, and patrons so that they can learn how to use newly introduced AT. Librarians can develop new skills in various ways: individual training sessions, demonstrations of AT in lab settings, instructional handouts, and Web-based tutorials. Therefore, administrators aim to provide substantive, hands-on professional development opportunities for librarians. Scupola and Nicolajsen [14] believe that improving the technological competencies of librarians is one of the most important necessities for introducing a new service in academic libraries. Potnis and Allard [63] identify four clusters of skills specific to technology, including programming, management, human-computer interaction, and information science, to help librarians better serve patrons using mobile technologies. We also found that administrators plan to encourage more librarians to undergo various technical and non-technical training.

When developing new information services or reconfiguring existing ones, librarians' interactions with patrons should be pleasant [15]. Administrators in our study plan to provide cultural and psychological training for librarians who are uncomfortable engaging with disabled patrons, or those who are insensitive to disabled patrons' needs. This training could increase librarians' empathy toward disabled patrons and enable them to have appropriate conversations with patrons. By treating disabled patrons with respect and dignity, librarians promote diversity and inclusion both in the library and across the institution. By completing such training, librarians may become more open and receptive to the fleet of changes associated with offering information services using AT.

#### *5.1.2.3 Automation*

Administrators in our study—who have limited, or no, librarians dedicated to serving patrons using AT—regularly search for guides, tutorials, and manuals as a means of providing “self-service” instruction to patrons. Automation, such as dedicated guides on library websites, as suggested by one librarian respondent, can reduce the burden on understaffed libraries. Better workflows, according to librarians in our study, would enhance the efficiency of information service delivery.

### *5.1.3 Innovation Mechanisms*

Innovation mechanisms are a set of actions by which new teams, processes, products, or services are created within an organization [64].

#### *5.1.3.1 Building New Teams*

Librarians in our study would like to work alongside an expanded task force with the skills required to offer AT-based information service. There is also a desire among librarians to recruit experts, who are disabled (e.g., visually-impaired librarians, hearing-impaired librarians) to improve the quality of information service offered to disabled patrons. Yeh and Walter [19] recommend creating dedicated innovation teams with high levels of autonomy so that academic libraries can better serve patrons using digital technologies. Around the United States, academic libraries with dedicated personnel yield successful outcomes (e.g., University of North Carolina, Chapel Hill's



Research Hub in the Davis Library). Administrators in our study plan to adopt a similar approach. They intend to form a library accessibility task force, in which librarians work with other staff members belonging to the ISS. However, none of the administrators mention granting decision-making authority to these newly minted teams.

#### *5.1.3.2 New Outlook, Norms, and Methods for Seeking Funds*

Most respondents expressed the need for external and internal grants and plan to apply for them. They seemed to be in search of novel strategies for seeking funding. Negotiating budgets, searching for endowments, and renegotiating cost-sharing agreements among academic units, are some of the high-priority activities they plan to undertake. Librarians, particularly, proposed new norms, including establishing a recurring budget line for purchasing and updating AT and allocating a regular portion of the budget for AT-based information service delivery. These changes can reduce the financial uncertainty associated with serving disabled patrons. For respondents, funding will be used for renovating physical spaces, purchasing additional licenses for AT, recruiting librarians who possess needed expertise (e.g., proficiency in American Sign Language, evaluating a voluntary product accessibility template (VPAT), negotiating contracts), employing librarians dedicated to providing AT, and purchasing more AT training resources. Administrators hoped to relieve staff members with multiple responsibilities, such as librarians who oversee both ADA compliance and AT operations.

#### *5.1.4 Moral and Ethical Responsibilities as a Cognitive Mechanism*

Individual cognition is critical for building high-quality connections among different units of an organization since an individual's perceptions of other people shape their orientations toward, and connections with, those people. Cognitions inform actions; hence, we believe librarians' perceptions of disabled patrons can determine how fairly they treat those patrons. If a library employee views a disabled patron as deserving of his or her attention, then the employee will be more likely to help them find the information they need. As a result, the patron may feel included. However, if the employee harbors prejudice toward individuals with disabilities, then the patron

may be ignored and left dissatisfied with the library experience. This ethical dilemma demonstrates the essential role of cognition in librarians' treatment of disabled patrons. Administrators in our study believe librarians should be held more accountable when delivering AT to serve disabled patrons. They propose creating awareness about librarians' moral and ethical responsibilities when interacting with these patrons. Further, librarians' roles and responsibilities should be clearly articulated so that the quality of library service is unparalleled.

Librarians in our study think that information services should be designed, planned, and offered with accessibility as a core principle. Accessibility should not be treated as an add-on feature of any information service: an information services librarian suggests that "accessibility [be] part of [the] initial conversation rather than [an] afterthought."

#### *5.1.5 Integrating AT with Space and Facilities*

This mechanism indicates the integration of technology with other cross-functional (i.e. non-technical) resources in organizations [65]. Most administrators in our study set cross-functional objectives for offering information services using AT. For instance, they strive to better integrate AT with library space. The efficient management of space is on the agenda for respondents. Currently, several administrators do not believe that their libraries contain the necessary space for installing AT. Some administrators plan to reserve larger spaces in their libraries for hosting AT. Librarians also support the provision of more space for AT. Others note that setting up user-friendly spaces for students with psychological disorders (e.g., ADHD, PTSD) would be beneficial, so those students remain anonymous and feel comfortable using AT. In some cases, respondents plan to retrofit their physical spaces, but not necessarily their AT. Their main purpose is to better integrate AT into computer spaces so that physical access issues can be satisfactorily addressed. Overall, administrators expect to (a) create a more supportive infrastructure that better serves disabled patrons, (b) make efficient and creative use of existing spaces, and (c) provide additional space to house AT.

## **6. Theoretical Contribution: Information Value Chain**

In *The Competitive Advantage of Nations*, Porter [66] proposes a value chain in the form of a set of primary and support activities that build competitive advantage for an organization. The author concludes that: “firms gain competitive advantage from conceiving of new ways to conduct activities, employing new procedures, new technologies, or different inputs (p. 41).”

The ten mechanisms in section 5 above represent the new ways of conducting activities [21, 23] in academic libraries. By reconceptualizing service delivery using AT, and receiving resources from stakeholders, academic libraries can give themselves a competitive advantage when serving disabled patrons.

Importantly, all these mechanisms involve information-centric reorganizations of work practices. For instance, the “environmental scan” involves extensive searching, gathering, and compilation of information (See 5.1.2.1). “Improving dialogue with patrons” requires carefully framing information when sharing it with patrons (See 5.1.1.3). “Automation” consists of identifying, compiling, and reusing information when creating self-service manuals for patrons (See 5.1.2.3).

Along the same lines, we propose six information-intensive activities that academic libraries would need to undertake when implementing these mechanisms. For instance, scanning the environment (See 5.1.2.1), communicating with internal partners (See 5.1.1.1), receiving training (See 5.1.2.2 and 5.1.2.3), collecting feedback from patrons (See 5.1.1.3), seeking consultation (See 5.1.1.2), and partnering with external stakeholders (See 5.1.3.1 and 5.1.1.2), involve searching, compiling, mixing, framing, sharing, or reusing information, and learning from it.

However, without adequate support in the form of funding, staff, and AT, among other resources, academic libraries cannot implement the above information-intensive activities. The five supporting activities include the ISS infrastructure (See 5.1.3.1 and 5.1.1.1), human resource management (See 5.1.3.1), funding of AT (See 5.1.3), procurement of AT (See 5.1.3.2), and

management of AT (See 5.1.5 and 5.1.4). These supporting activities enable the ISS to carry out the primary information-intensive activities.

If academic libraries implement the above six primary activities with the help of five supporting activities, they can improve the quality of information services offered to disabled patrons. Improving service quality can lead to a competitive advantage for organizations [67]. Hence, in line with Porter's value chain [66], we propose an information value chain for better serving patrons using AT (See Figure 1). Porter's value chain model embraces an inherently economic understanding of value, which has been the primary criticism of the model [51]. This criticism does not apply to our study since "improving information services" – not generating profits – is the primary goal of academic libraries.

[insert Figure 1]

**Figure 1. Information Value Chain for Improving Information Services Using AT**

Table 2 maps the ten mechanisms (listed as columns) onto the six primary and five supporting activities (listed as rows) in the proposed value chain. For instance, the "building new teams" mechanism (in column 7) would require academic libraries to partner with external stakeholders, thereby leveraging the existing ISS infrastructure, human resources, and AT funds (See 5.1.3.1). Similarly, unless librarians and administrators feel morally and ethically responsible for serving disabled patrons (See column 9), go through appropriate cultural and psychological training (i.e., column 5), and learn to integrate AT with library space (See column 10), they would not be able to manage AT in academic libraries for creating value for disabled patrons (See 5.1.4 and 5.1.2.2). Repositioning of current ties with other units in ISS and external partners (See column 2) would help academic libraries seek guidance from collaborators on campus, and partner with external stakeholders, respectively (See 5.1.1.2).

Primary Activities	Mechanisms									
	1	2	3	4	5	6	7	8	9	10
Scanning the environment				x						

Communicating with internal partners	×									
Receiving training					×	×				
Collecting feedback from patrons			×							
Seeking consultation		×								
Partnering with external stakeholders		×					×			
<b>Supporting Activities</b>										
ISS infrastructure	×						×			
Human resource management							×			
Funding of AT							×	×		
Procurement of AT								×		
Management of AT					×				×	×

1: Strengthening existing partnerships; 2: Repositioning current ties; 3: Improving dialogue with patrons; 4: Environmental scan; 5: Professional development of staff; 6: Automation; 7: Building new teams; 8: New outlook, norms, and methods for seeking funds; 9: Moral and ethical responsibilities; and 10: Integrating AT with space and facilities

*Table 2: Mapping of Mechanisms onto Information Value Chain*

The service innovations proposed in our paper involve information-centric reorganization of work practices, and hence, are useful in implementing Porter's value chain for improving the delivery of information services to disabled patrons using AT. The existing research on service innovation does not propose an information value chain, which is the major theoretical contribution of our study. The extant research on the information value chain primarily focuses on the information life cycle, including the process of converting data into knowledge via information, and managing and applying information for specific organizational tasks [68, 69]. The proposed information value chain exploits, integrates, and exchanges information generated, shared, and used by internal and external actors belonging to an ISS.

Our proposed information value chain emphasizes the significance of information-related operations. The ultimate objective is to transform information into value-creating activities, which translates into benefits for patrons, a major challenge for organizations engaged in service innovation [26]. The proposed information value chain can also lead to the rerouting of information in academic libraries, thereby challenging existing relationships among actors.

## **7. Conclusion, Limitations, & Future Research**

Findings can guide academic libraries and other information organizations in designing and implementing more user-centric information services. Any academic library interested in service innovation can benefit from our mechanisms since none of the existing guidance for implementing service innovations asks libraries to consider all of the following activities: (a) environmental scanning of existing technologies and services offered by other units across campus, (b) professional development of staff, (c) accountability of staff when serving patrons, (d) automation of work practices in serving patrons, and (e) retrofitting of spaces in libraries. Findings can also help library administrators better engage with stakeholders and elevate the strategic role of academic libraries in their respective institutions. These modified work practices presented in this paper could be useful in developing an information value chain for enhancing the quality of services provided by organizations.

Finally, we conclude that information services are complex, adaptive systems that cannot always be planned. Information services may need to evolve through the reconfiguration of existing resources and the creation of value for patrons. These modified work practices presented in this paper could be useful in developing an information value chain for enhancing the quality of services provided by organizations.

Due to our limited resources, the scope of our study was limited to academic libraries in the U.S. News & World Report's top-200 universities. The low response rate is another limitation of our study, and consequently, our study's findings do not necessarily represent or apply to all academic libraries in the United States. However, findings are useful for extending understanding

of the AT in libraries and help enhance the value and delivery of information services to disabled patrons.

Our proposed ISS and information value chain can be tested in the context of service innovations in different types of information organizations to check the extent to which they meet the information needs of patrons. For instance, multiple stakeholders involved in offering information service to patrons can be interviewed or surveyed. Questions might include the degree to which primary and supporting activities are implemented in organizations, the benefits of information services experienced by patrons, and the role of each activity in improving the quality of information services offered to patrons. The role of information in service innovations can also be studied in different organizations.

The information-centric reorganization of work practices presented in our paper could encourage service innovation researchers to understand and apply the vast body of information science research on seeking, searching, managing, processing, and applying information [70] for service innovation. Future research at the intersection of information behavior and the information value chain can (a) advance our understanding of the role of information in building competitive advantage, and (b) help organizations create optimal value for their patrons using information.

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## APPENDIX. ABRIDGED SURVEY INSTRUMENT

1. Please select the type of your library.
  - a. Academic
  - b. Public
  - c. School
  - d. Special
  - e. Other: \_\_\_\_\_
2. What is the operating budget of your library in this fiscal year?
  - a. less than \$25,000
  - b. \$25,000 – \$50,000
  - c. \$50,001 – \$100,000
  - d. \$100,001 - \$200,000
  - e. \$200,001 - \$500,000
  - f. \$500,001 - \$1 million
  - g. Greater than 1 million
3. What is your job title? \_\_\_\_\_
4. Are you one of the administrators in your library?
  - a. Yes
  - b. No
  - c. Other: \_\_\_\_\_
5. Does your library have any assistive technologies?
  - a. Yes
  - b. No
  - c. Don't know
  - d. Other: \_\_\_\_\_
6. How did/does your library address the challenges/barriers/issues when...
  - a. Realizing the need to have assistive technologies in libraries: \_\_\_\_\_
  - b. Searching for assistive technologies in the marketplace: \_\_\_\_\_
  - c. Evaluating various choices available in the marketplace: \_\_\_\_\_
  - d. Negotiating with vendors: \_\_\_\_\_
  - e. Crafting agreement or service contract with vendors: \_\_\_\_\_
  - f. Training library staff for serving disabled patrons using newly purchased assistive technologies: \_\_\_\_\_
  - g. Designing library policies for disabled patrons when using assistive technologies: \_\_\_\_\_
  - h. Deploying assistive technologies in the library: \_\_\_\_\_
  - i. Operating/maintaining assistive technologies: \_\_\_\_\_
  - j. Providing access to disabled patrons: \_\_\_\_\_
  - k. Helping patrons use assistive technologies: \_\_\_\_\_
  - l. Helping patron benefit from assistive technologies: \_\_\_\_\_
  - m. Other: \_\_\_\_\_

7. In the future, which three internal changes could help your library serve patrons better using assistive technologies?

**Figure 1. Information Value Chain for Improving Information Services Using AT**

